TELESCOPE SECTIONED MOMENT COLUMN

Cross-Reference to Related Application

This application claims priority to U.S. Provisional Patent Application Serial No. 60/460,624, filed April 3, 2003, for "Telescope Sectioned Moment Column and Method". The entire contents of this provisional case are hereby incorporated herein by reference.

Background and Summary

This invention pertains to the construction and employment of a structural column. In particular, it relates to such a column which is cross-sectionally tapered, in a stepped fashion, from one end to another by virtue of its being formed with, and by, plural, telescopically nested, hollow and elongate sections that, in fully assembled conditions, longitudinally overlap one-another to furnish moment, load-bearing connections between next-adjacent sections. It relates also to the use of such a column in a multi-story building frame structure.

Hollow column structures conventionally used for assembly in a structural building frame are desirable for many well-known reasons. Two of these reasons are (a) that such columns usually possess a relatively low ratio of weight to load-bearing capability, and (b) that they are normally modest in expense. The present invention recognizes these and other column-desirability features, and adds several new features which significantly improve the scope of desirability in many applications.

Proposed by this invention is a columnar structure (a column) which is defined by plural, telescopically nested, elongate and hollow column sections. Intermediate the upper and lower ends of the proposed column structure, where two vertically adjacent sections meet one another, and with the column structure readied for use, each upper

section in a meeting pair of sections has an end which extends a selected overlap distance into the end of the next-adjacent, lower, larger-cross-section column section. This overlap produces a robust moment (load-bearing) connection between each two such "end-to-end" disposed column sections. Next-adjacent, vertically overlapping sections are joined in any suitable fashion, such as by welding, to function as a unit.

The finished column structure thus tapers in a stepped fashion from section to section, and is disposed for operation in a building frame with its cross-sectionally larger end at the base of the column, and its cross-sectionally smaller end at the top of the column. The column is typically, though not necessarily, employed with its larger end located substantially at the base of a building frame structure. In contrast, in a frame structure which rises from a podium sub-structure, the base of a column is usually effectively seated and appropriately anchored on top of such a sub-structure.

While the column structure of this invention may be delivered fully assembled to a job site with sections pre-anchored (welded) to one another, one of the important features of, and options offered by, the invention is that a column structure may alternately be delivered unassembled to such a site in the form of fully-nested, relatively moveable sections -- one inside another. Such a delivery possibility adds, among other things, great convenience in the matter of shipping. At the job site, such telescopically pre-nested sections may be "un-telescoped", and then and there anchored to one another.

The "stepped" tapering of a completed column structure is a lower-cost column unit in comparison with a similar-length conventional column that effectively possesses a uniform cross-section along its length. Additionally, the stepped/tapered nature of the proposed column structure offers an arrangement which recognizes that progressively

higher regions in a building frame structure typically are presented with lesser moment and gravity loads to manage.

In the setting of a multi-story building frame structure, laterally adjacent columns made in accordance with the invention are load-bearingly interconnected by horizontally extending elongate beams having opposite ends suitably anchored to the appropriate column sections. Where such anchoring exists at what are called anchoring zones herein, adjacent the locations where two, vertically next-adjacent column sections overlap to form a moment joint in the associated column, anchoring takes place preferably to the outside of the larger cross-section one of the two particular column sections.

These and other features and advantages which are offered by the column structure of this invention will become more fully apparent as the detailed description which now follows is read in conjunction with the accompanying drawings.

Description of the Drawings

Fig. 1 is a simplified and fragmentary illustration of a building frame structure employing plural column structures, or columns, constructed with plural column sections in accordance with a preferred and best-mode embodiment of the present invention. These columns are shown interconnected by horizontally extending beams.

Fig. 2 is a view isolating and fragmenting one of the assembled column structures employed in the building frame structure of Fig 1. For illustration purposes, only three sections of such a column structure are shown, with weld connections (anchoring connections) existing between next-adjacent sections.

Fig. 3 illustrates, fragmentarily, the three sections of one of the column structures shown in Figs. 1 and 2 in conditions with these sections fully telescoped and nested, and not yet anchored to one another.

Figs. 4 and 5 present cross-sectional views taken generally along the lines 4-4 and 5-5, respectively, in Fig. 2. In order to simplify these views, normal surface markings rather than cross-sectional markings are employed in these two figures.

Detailed Description of the Invention

Turning now to the drawings, and beginning first of all with Fig. 1, shown fragmentarily at 10 is a multi-story building frame structure formed with plural, upright, laterally spaced, plural-section column structures 12 which are interconnected by horizontal beams 14. Column structures (or columns) 12 are configured in accordance with a preferred and best-mode embodiment of the invention. The long axes of columns 12 are shown at 12A. The exact natures of the column/beam interconnections, shown generally at 16, are not important to an understanding of the present invention, and thus are only represented herein schematically. However, where beam/column inter-connections exist adjacent the locations where different-size column sections (still to be described) join and overlap with one another, as is particularly shown in the frame structure pictured in Fig. 1, anchoring of a beam end effectively to a column preferably takes place specifically with respect to the larger cross-section one of the two vertically next-adjacent column sections. These locations where such interconnections exist are referred to herein also as anchoring-connection regions.

Frame structure 10 rises from its base 10a, and from a suitable supporting foundation 18. For descriptive purposes herein, it is sufficient simply to state that the bases of column structures 12 are appropriately anchored to this foundation.

Including reference now additionally to Figs. 2-5, inclusive, and as has been previously stated herein, column structures 12 are made in accordance with a preferred and best-mode embodiment of the invention. While different numbers of plural sections may be employed for a column structure made in accordance with the present invention, each of structures 12 as illustrated herein is formed with three telescopically nested sections 12a, 12b, 12c. Each of these sections is hollow and tubular along its length, and each has a square cross section -- also referred to herein as a defined cross section. These cross sections are referred to herein as matching-character cross sections. The cross section of section 12a is larger than that of section 12b, and the cross section of section 12b is larger than that of section 12c. Figs. 3, 4 and 5 especially illustrate the fact that column section 12b fits snuggly and telescopically within column section 12a, and that column section 12c fits snuggly and telescopically within column section 12b. While the overall effective lengths (heights in frame structure 10) of the illustrated column sections may span (vertically) plural stories in a frame structure, in frame structure 10, each column section effectively so spans just a single story.

Figs. 1, 2, 4 and 5 illustrate a condition wherein each column structure 12 is fully assembled (with sections welded to one another) in an "extended" condition for use. In this condition, column section 12b extends upwardly from column section 12a, and has a lower end length portion $12b_1$ which extends a vertical overlap distance L_1, into an upper end length portion $12a_1$ of column section 12a. Similarly, column section 12c, which

extends upwardly from column section 12b, has a lower end length portion $12c_1$ which extends a distance L_2 into an upper end length portion $12b_2$ of column section 12b. Distances L_1 and L_2 are not necessarily the same. The regions of section longitudinal (vertical) overlaps (L_1, L_2) which are defined by these two distances form robust moment connections between the respective associated pairs of the vertically next-adjacent column sections. Column sections 12a, 12b, 12c are joined and anchored to one another herein via welds, such as those shown generally at 20 in Fig. 2.

Other joinery approaches between column sections may, of course, be employed if desired. For example, the various sections might be delivered to a job site in separated and disassembled conditions, with each "smaller cross-section" column section which is intended to fit within, and rise from, another, "larger cross-section" section, pre-fitted, so-to-speak, appropriately on it lower "outside" surface with a secured "stop structure", such as a welded-on-plate. Such a plate will assuredly define the length by which the smaller column section can and will extend into the upper portion of what will become the associated, immediately lower and supporting larger column section. At the job site, with a "lower" column section in place and upright, continued, upwardly extending column assembly becomes the very simple and speedy matter of simply lowering and inserting the lower end of the next, smaller column section to the point where the stop structure on the smaller section engages and prevents further lowering of that column section.

At an appropriate time following lowering of the upper column section into a lower section, rigid securement can be accomplished in any suitable manner, as by welding. Such assembly, of course, immediately defines the proper relative longitudinal positioning of the two thus interconnected column sections, and most importantly also

immediately establishes a significant moment connection between the two column sections.

Thus one can see that the fully assembled column structures (columns) have a step-tapered characteristic progressing from one end (lower end) to the other end (upper end). In frame structure 10, the larger ends of the column structures are below the smaller ends, and the column structures rise directly from foundation 18. In another form of frame structure than that pictured in Fig. 1, the column structures of this invention might, instead of being employed rising directly from the underlying foundation, begin their employment at some level above the traditional foundation, as, for example, with respect to a podium structure which might define the lower story, or stories, of a building structure. In point of fact, exactly where column structures made in accordance with this invention are actually placed is a matter of designer choice.

Clearly, in a frame-structure region where these column structures 12 are employed, overall column mass is smaller than it would be were conventional column elements to have been used instead. Thus, less material usage and expense are characteristic contributions of these structures 12. Importantly, such material and cost savings are achieved and offered by structures 12 without any attendant diminution of frame strength and necessary performance capability, inasmuch as progressively lower overhead load-bearing frame responsibility is called upon as one moves upwardly in a building structure. Step-tapered structures 12 uniquely recognize and take advantage of this opportunity to offer significant material and cost savings, without loss of necessary load-bearing capabilities.

Very significantly, robust, high-capacity moment connections come into existence between vertically adjacent column section substantially instantly as the upper one of two such sections is inserted /lowered into the lower column section.

As has been mentioned, structures 12 may be delivered to a job site in various conditions, including (a) in a fully assembled and extended configuration (at least for a certain number of column sections), (b) in fully telescopically nested conditions wherein they can conveniently and compactly be delivered in not yet at all assembled conditions, and (c) in unassembled, unnested conditions with assembly-defining "stop structures" in place.

It will also be apparent, and it was mentioned earlier herein, that while structures 12 are illustrated in this disclosure including three nested sections, a column structure constructed in accordance with this invention can have any appropriate plural number of sections.

Thus the invention proposes a novel and effective, elongate structural column arrangement which is defined by plural, telescoping, nested, hollow and elongate sections. In unfinished/unassembled form, the sections in a given column structure can conveniently and compactly be handled, among other ways, in fully nested, space-saving conditions. When sections are appropriately assembled and anchored to one another, suitable longitudinal nesting-overlaps between adjacent sections provide robust and significant moment connections between adjacent column sections. The resulting step-tapered structure of a column constructed in accordance with the invention takes special advantage of the declining "overhead" load-bearing requirements (discussed above) in the upper reaches of a building frame structure. These novel structural columns thus

offer the opportunity to create unique multi-story building frame structures which offer impressive moment and gravity load-handling capabilities, while simultaneously also offering construction handling and assembling simplicities, and material and labor-saving cost advantages.

Those generally skilled in the art may well observe that numerous variations and modifications of the proposed structure may be made without departing from the spirit of the invention.